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ON THE

FUTURE EXTENSION

OF

BIRMINGHAM INDUSTRIES.

BY

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ON THE FUTURE EXTENSION OF BIRMINGHAM INDUSTRIES.

(By G. Gore, F.R.S.)

The object of the following remarks is to call public attention to a greatly neglected means by which the trades of Birmingham may be extended.

Many persons are of opinion that foreign nations are gradually supplanting England in most of her manufactures, and evidence in support of this opinion has from time to time been given before Government Committees; but whether this opinion is or is not correct, there can be no doubt that any reasonable proposal for maintaining and increasing the trade of this town is worthy of notice.

It will be well to consider by what general means the chief trades of this town were first originated and improved; and whether we can by similar means, but applied in a more effectual manner, lay the foundation of other new trades and improvements.

It is manifest that many of our trades and manufactures, those of glass and iron for example, are of such great antiquity, it is impossible to ascertain with certainty the special circumstances under which they originated; but after we have considered the ways in which various modern trades and manufactures have first arisen, we shall come to the conclusion that all manufactures and improvements in manufacturing processes must have been first produced by the same general means, although the special circumstances connected with the origin of each were different.

Let us consider german-silver and its manufacture. That substance is an alloy of copper, zinc, and nickel; it owes its peculiar whiteness or "silver-like" appearance to the latter metal, and cannot be made without it; it is certain, therefore, that by whatever means that metal or the alloy was discovered, the discovery was the origin of the german silver manufacture, and was essential to all manufactures, processes, or appliances in which german-silver, nickel, or any of its compounds are used. Nickel was discovered by Cronstedt during the year 1751, and its compounds were chiefly investigated by English and foreign chemists. Cronstedt found it as a peculiar metal

in the mineral called kupfernickel, whilst chemically examining the properties of that substance. The general method by which he discovered it was careful experiment, observation, and study of the properties of matter.

I believe it is a fact that the Chinese and other nations made alloys of nickel long before nickel itself was known to be a separate metal; they had found, by experiment, that when ores of copper and zinc were mixed with a particular kind of mineral and smelted, a white alloy was obtained; but this also proves the general statement already made, that the german-silver manufacture was originated by means of experiment and observation. It was by a more skilful, but similar, mode of procedure that Cronstedt discovered the metal itself, and thus laid the basis of improvements in the manufacture of its alloys.

I need not here enlarge upon the multitude of uses to which nickel has already been applied in Birmingham manufactures, nor speak of the large sums of money which have been and still are made by means of it and its compounds, as those are facts better known to many of your readers than to myself.

The manufactures of iron-wire and copper-wire for telegraphs are two other modern trades of great magnitude in this town, and were originated in the following manner:—In 1799, Volta, an Italian philosopher, was experimenting, observing, and studying the electric properties of metals in liquids, and discovered the voltaic battery. In 1815, Professor Oersted, of Copenhagen, was experimenting on the relation of electric currents to magnets, and he observed that when a magnet was suspended near and parallel to a horizontal copper-wire, through which an electric current was passing, the magnet moved spontaneously, and placed itself at right angles to the wire. From these two small experiments, made by putting matter and its forces under new conditions, observing and studying the results, all our telegraphs and the immense manufactures of iron and copper telegraph wire have arisen.

There is a saying, that "all great things have had small beginnings," and this is true, not only of electric telegraphs, but also of the great trade of electro-plating, and of the magneto-electric machine which is now largely used instead of the voltaic battery. After Volta had made his small and apparently unimportant experiments on the electricity produced by metals and liquids, various persons tried the effect of that electricity upon metallic solutions. Brugnatelli, in 1805, found that two silver medals became gilded in a solution

of gold, by passing the electricity through them. Mr. Henry Bessemer, in 1834, coated various lead ornaments with copper by using a solution of copper in a similar manner. And in 1836 Mr. De la Rue found that copies might be taken in copper of engraved copper plates by the electro-depositing process. Faraday discovered magneto-electricity in the year 1831, by rotating a disc of copper between the poles of a magnet, and he has stated that the first successful result he obtained was so small that he could hardly detect it. This simple experiment was the origin of the magneto-electric machine, and many of those machines are now used by Messrs. Elkington for depositing copper, silver, and gold, instead of by the voltaic battery.

Another large manufacture of this district is that of phosphorus. The origin of it is due to the man, whoever he was, who first isolated that element. Histories of chemistry tell us that it was discovered by Brandt, a merchant of Hamburg, in 1669, but evidence exists that it had been obtained in the separate state very many years before by the early Arabian chemists. Brandt obtained it by distilling a mixture of direct residue of urine and charcoal. His discovery was also made by careful experiments, and observation of the properties of matter, and had it not been made there would have been no manufactures of phosphorus or phosphorus matches in this district.

Priestley made many experiments on the absorption of gases by water, and proposed such liquids as beverages, and those apparently trifling experiments have since expanded into the large manufactures of aërated waters.

Persons inexperienced in scientific matters are apt to think that discoveries are generally made by accident. The reverse is, however, the case; nearly all our great modern discoveries were effected by men who were constantly making careful experiments upon the properties of matter and its forces, by subjecting them to new and definite conditions. Nearly all persons look upon such discoveries as fortunate ideas, which, when once found, are quickly developed, instead of which they are in most cases slowly developed results of most difficult mental labour.

Discoveries in science are occasionally made, not by original scientific investigators, but by practical men engaged in manufacturing or technical employments. The hydro-electric machine originated in this way: a man at Newcastle was attending to a steam-boiler, and found that he received electric shocks when he touched the boiler. This circumstance was investigated by his

employer, Mr. Armstrong, a scientific man, and led him to construct the hydro-electric machine. The accumulation of electricity in submarine telegraph cables was also first observed at the Gutta-Percha Company's works, London. It was noticed on testing the cable by means of a voltaic battery (the cable being submerged in water) that discharges of electricity flowed from the cable after the battery was removed; this circumstance was investigated by Faraday, and led to improvements in submarine telegraphy. In these instances also the same general method was employed, viz., new experiments were made (though not intentionally) by putting matter and its forces under new conditions, and new results were observed.

Many improvements in machinery, manufactures, and trades are effected either by inventors who occupy their lives in making inventions and patenting them, or by practical men engaged in trades and manufactures. These improvements are also effected by means of experiment, observation, and study; and each of these classes of men are largely indebted for the knowledge they employ to those scientific observers who previously discovered and made known in books the properties of the substances and forces they require to use. Watt acknowledged that he could not so largely have improved the steam engine had he not learned from the discoveries of Dr. Black "what was the heat absorbed and rendered latent by the conversion of water into steam."

In making an improvement—in machinery, for example—a practical man requires to study the influence of many laws and properties of bodies, of which, as a workman, he would be quite ignorant. An ordinary workman in a manufactory works largely by routine, and becomes very familiar with a few properties of the substances with which he has to deal, but remains almost entirely ignorant of the greater number of properties which those substances possess. The properties of a single substance are so numerous that if a workman was to thoroughly study the whole of them, he would become a scientific authority in the subjects of heat, light, electricity, magnetism, and chemistry. A blacksmith who knew all the physical and chemical properties of iron and steel would be quite a scientific philosopher. It is said that "an ounce of practice is worth a pound of theory;" but we must not forget that however valuable the ounce of practice is without the theory, it is very much more valuable with it.

Scientific discovery, therefore, by developing new facts and laws relating to matter and its forces, constitutes not only the basis of new

manufactures, but largely, also, of the improvements in trades, made by inventors and practical men; and if discoveries are not made, the means by which improvements are effected by such men will become exhausted. The great value of new scientific knowledge to such men is proved by the fact, that when new scientific discoveries are published, there are numerous inventors and practical men who immediately endeavour to apply them to useful purposes. Since the first application of coal-tar to the production of dyes, every discovery in that branch of chemistry has been closely watched for a similar purpose.

According to all our experience, scientific discovery provides the knowledge necessary for making inventions, and practical inventions lead to increase of trade. It might easily be shown that in this way scientific research has already resulted in the employment of whole armies of workmen, and in the expenditure and investment of a fabulous amount of money in railways, telegraphs, machinery, gasworks, chemical works, electro-plating, photography, &c., &c., in this country; and Birmingham has received a large share of the benefit.

The future success of this town and district is dependent upon original scientific research, to a degree of which persons in general can form but little conception. Hundreds of millions of pounds are being expended in covering the earth with telegraphs, and thousands of millions in covering it with railways, gasworks, waterworks, &c., and Birmingham and its district has its share in supplying the rails, the wire, and the machinery. In this country alone more than 550 millions of pounds have been already expended upon railways only.

Original scientific research is the great fountain-head of industry, and its capability of developing increased trade is practically unlimited; it is at present quite in its infancy, and we are only on the very threshold of a knowledge of the forces of nature, and of the constitution of material substances; and, if such enormous results are being produced by the beginnings of unaided science, what may be expected from its future developments, especially if scientific research is assisted in an effectual manner?

Numerous important subjects of investigation, capable of yielding valuable results bearing upon the trades of this town, exist in all directions. Researches in electricity and in inorganic chemistry, particularly the metals and their compounds, would probably lead, as they have done

before, to the establishment of new trades, and to improvements in local manufactures, and thus lay the foundation of future commercial prosperity. Discoveries in science, however, are best made, not by trying to obtain some valuable commercial or technical result (that object belongs to an inventor), but by making new, reliable, and systematic investigations. By investigating the chemical action of electricity upon saline bodies, Sir Humphry Davy isolated sodium and magnesium, which has led to the recent establishment in Manchester of the manufactures of those metals. By the abstract researches of Hofmann and others upon coal-tar, the immensely profitable manufacture of the splendid coal-tar dyes was originated.

Scientific discovery is the most valuable in its ultimate practical results when it is pursued from a love of truth as the ruling motive, and any attempt to make it more directly and quickly remunerative to this town by trying to direct it into practical channels will decrease the importance of its results, diminish the spirit of inquiry, and sooner or later reduce it to the character of invention. The greatest practical realities of this age had their origin, as I have already shown, not in invention or a search for utilities, but in a search after important new truths, entirely irrespective of what utilities they might lead to.

I do not intend by these remarks to imply that any new trades or improvements in manufactures have been or can be effected without the labours of inventors and practical men, but that there should be a more judicious division of labour: one man to discover new truths, another to put them into the form of practical inventions, and the practical business man to work them; because it is proved by experience, that in nearly all cases these different kinds of labour require men of widely different habits of mind, and that the faculties of discovery, invention, and practical manufacture are very rarely united in one man.

Our large manufacturers and men of business have accepted and employed the advantages of science in an endless number of ways in their occupations, and have thereby acquired great wealth; but, notwithstanding this, and that the greatest trades of this district were originated and improved largely by means of scientific investigation, scarcely any of the wealthy manufacturers or landholders of the locality, who have derived such great benefits from the increase of trades, give the least assistance to scientific research; that which is the duty of all has been attended to by none. The probable explanation is, original scientific research is a subject

quite outside the experience and knowledge of persons in general.

It may be objected that such research is not aided, because it sometimes takes a long time to acquire a practical shape and make it pay. We do not omit to plant an acorn because it requires many years to become an oak; we do not neglect to rear a child because he may not live to become a man; but we leave scientific discovery to take care of itself.

Our practice with regard to science is very different from the plan carried out in Germany. Within the last few years great laboratories have been erected in Berlin, Leipzig, Aix la Chapelle; Bonn, Carlsruhe, Stuttgardt, Griefswald, and other places, at the expense of the State, and special provision has been made in them for original scientific research. A glance at the frequently published list of scientific investigations made in different countries will show us that the Germans are making a far greater number of discoveries in science than ourselves. If we are to maintain our position as a manufacturing nation, we also must adopt special means to promote scientific research; for how can we expect to obtain new arts and manufactures, or improvements in old ones, if we do not make new discoveries in the properties of matter and its forces?

I need not multiply instances of the essential dependence of our present commercial success upon abstract scientific research, but may safely affirm that nearly all our great manufactures have been originated by means of experiment, observation, and study of matter and its forces; and that the great bulk of the improvements made in manufactures by practical men could not have been effected had not scientific investigators discovered, and made known in books, the properties of bodies.

The inference from these conclusions is obvious: by adopting similar means, but in a more effectual way, we shall obtain similar but more successful results. At present, original scientific researches are generally made by teachers of science, who spend a portion of their scanty incomes in making experiments, and lead lives of great self-denial in the labour. There is absolutely no provision in this country for the support of scientific investigators, and thus the great source of new trades and improvements in manufactures remains undeveloped. I propose, therefore, that a fund be raised for the purpose of aiding scientific men in making original investigations in accordance with the views set forth in this article.